Claims

1. A method for identifying a type of impairment in a system communicating a digitally modulated signal comprising the steps of:

obtaining soft decision data derived from the digitally modulated signal;

applying an impairment mask to the soft decision data;

determining a subset of the soft decision data that occur within the impairment mask; and

calculating a correlation weight based on the subset.

2. The method of claim 1 further comprising the step of:

normalizing the soft decision data.

3. The method of claim 2 wherein the impairment mask is selected from a group consisting of:

a phase noise impairment mask;

a continuous wave noise impairment mask;

a signal reflection impairment mask;

an I/Q imbalance impairment mask;

a compression impairment mask;

an amplitude-modulation-to-phase-modulation impairment mask; and

a composite phase noise and continuous wave noise impairment mask.

4. The method of claim 1 further comprising the step of:

providing a three-dimensional presentation of a distribution of the soft decision data over time.

5. The method of claim 1 further comprising the step of:

providing information descriptive of a distribution of occurrences of soft decision data within specific regions of the impairment mask.

6. The method of claim 1 further comprising the step of:

reporting a likelihood that a type of impairment corresponding to the impairment mask is affecting the digitally modulated signal.

7. A method for detecting impairment of a digital signal comprising the steps of:

calculating a first correlation weight for a first symbol-level impairment mask;

storing the first correlation weight;

calculating a second correlation weight for a first constellation-level impairment mask;

storing the second correlation weight; and

calculating an overall correlation weight based on the first correlation weight and the second correlation weight.

8. The method of claim 7 further comprising the steps of:

calculating a third correlation weight for a second symbol-level impairment mask;

storing the third correlation weight;

calculating a fourth correlation weight for a second constellation-level impairment mask; and

storing the fourth correlation weight, wherein the step of calculating the overall correlation weight based on the first correlation weight and the second correlation weight further includes the step of calculating the overall correlation weight based on the first correlation weight, the second

correlation weight, the third correlation weight, and the fourth correlation weight.

9. The method of claim 8 further comprising the step of:

measuring a quality of the digital signal.

10. The method of claim 9 wherein the step of measuring a quality of the digital signal further comprises the step of:

checking a signal-to-noise ratio.

11. The method of claim 7 wherein the first symbol-level impairment mask is selected from a symbol-level impairment mask group consisting of:

a phase noise impairment mask;

a continuous wave noise impairment mask;

a composite phase noise and continuous wave noise impairment mask; and

a signal reflection impairment mask;

and wherein the first constellation-level impairment mask is selected from a constellation-level impairment mask group consisting of:

an I/Q imbalance impairment mask;

a compression impairment mask; and

an amplitude-modulation-to-phase-modulation impairment mask.

12. A digital receiving apparatus comprising:

a receiver responsive to a digitally modulated signal to perform conversion of the digitally modulated signal to soft decision data; and

an impairment correlator operatively coupled to the receiver and responsive to the soft decision data to correlate impairment of the digitally modulated signal.

13. The digital receiving apparatus of claim 12 further comprising:

a memory device operatively coupled to the impairment correlator to store impairment masks.

14. The digital receiving apparatus of claim 13 further comprising:

an error vector magnitude mask subsystem operatively coupled to the receiver and responsive to the soft decision data to assess a quality of the soft decision data.

15. The digital receiving apparatus of claim 14 wherein the error vector magnitude mask subsystem further comprises:

a SNR analyzer operatively coupled to the receiver and responsive to the soft decision data; and

an error vector magnitude mask memory device operatively coupled to the SNR analyzer to provide an error vector magnitude mask to the SNR analyzer.

16. The digital receiving apparatus of claim 13 further comprising a system controller operatively coupled to the impairment correlator to receive a correlation weight from the impairment correlator and to effect control of the digital receiving apparatus in response to the correlation weight.

17. The digital receiving apparatus of claim 13 further comprising a system controller operatively coupled to the impairment correlator to receive a correlation weight from the impairment correlator and to effect control of a transmitter in response to the correlation weight, the transmitter operatively coupled to the receiver to provide the digitally modulated signal to the receiver.

18. The digital receiving apparatus of claim 13 further comprising a system controller operatively coupled to the impairment correlator to receive a correlation weight from the impairment correlator and to effect control of a medium in response to the correlation weight, the medium operatively coupled to the receiver to convey the digitally modulated signal to the receiver.

19. A cable modem comprising:

a cable modem receiver responsive to a downstream signal to perform conversion of the downstream signal to soft decision data; and

an impairment correlator operatively coupled to the cable modem receiver and responsive to the soft decision data to correlate impairment of the downstream signal.

20. The cable modem of claim 19 further comprising:

a memory device operatively coupled to the impairment correlator to store impairment masks.

21. The cable modem of claim 20 further comprising:

a cable modem transmitter operatively coupled to the impairment correlator to transmit a correlation weight from the impairment correlator to a cable modem termination system.

22. The cable modem of claim 20 further comprising an error vector magnitude mask subsystem operatively coupled to the cable modem receiver and responsive to the soft decision data to assess a quality of the soft decision data.

23. The cable modem of claim 22 wherein the error vector magnitude mask subsystem further comprises:

a SNR analyzer operatively coupled to the cable modem receiver and responsive to the soft decision data; and

an error vector magnitude mask memory device operatively coupled to the SNR analyzer to provide an error vector magnitude mask to the SNR analyzer.

24. A cable modem termination system comprising:

a cable modem termination system receiver responsive to an upstream signal to perform conversion of the upstream signal to soft decision data; and

an impairment correlator operatively coupled to the cable modem termination system receiver to correlate impairment of the upstream signal.

25. The cable modem termination system of claim 24 further comprising:

a memory device operatively coupled to the impairment correlator to store impairment masks.

26. The cable modem termination system of claim 25 further comprising:

a network management system operatively coupled to the impairment correlator to provide a corrective control signal to a cable modem transmitting the upstream signal.

27. The cable modem termination system of claim 25 further comprising an error vector magnitude mask subsystem operatively coupled to the cable modem termination system receiver and responsive to the soft decision data to assess a quality of the soft decision data.

28. The cable modem termination system of claim 27 wherein the error vector magnitude mask subsystem further comprises:

a SNR analyzer operatively coupled to the cable modem termination system receiver and responsive to the soft decision data; and

an error vector magnitude mask memory device operatively coupled to the SNR analyzer to provide an error vector magnitude mask to the SNR analyzer.

29. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for identifying impairment of a digitally modulated signal received by the machine, the method steps comprising:

applying an impairment mask to soft decision data derived from the digitally modulated signal;

determining a subset of the soft decision data that occur within the impairment mask; and

calculating a correlation weight based on the subset.

30. The program storage device of claim 29 wherein the method steps further comprise:

normalizing the soft decision data.

31. The program storage device of claim 30 wherein the impairment mask is selected from a group consisting of:

a phase noise impairment mask;

a continuous wave noise impairment mask;

a signal reflection impairment mask;

an I/Q imbalance impairment mask;

a compression impairment mask;

an amplitude-modulation-to-phase-modulation impairment mask; and

a composite phase noise and continuous wave noise impairment mask.

32. The program storage device of claim 29 wherein the method steps further comprise:

providing a three-dimensional presentation of a distribution of the soft decision data over time.

33. The program storage device of claim 29 wherein the method steps further comprise:

providing information descriptive of a distribution of occurrences of soft decision data within specific regions of the impairment mask.

34. The program storage device of claim 29 wherein the method steps further comprise:

reporting a likelihood that a type of impairment corresponding to the impairment mask is affecting the digitally modulated signal.

35. A method for identifying a type of impairment in a system communicating a digitally modulated signal comprising the steps of:

obtaining soft decision data derived from the digitally modulated signal; and

performing ratio analysis on the soft decision data.

36. The method of claim 35 further comprising the step of:

providing a three-dimensional presentation of a distribution of the soft decision data over time.

37. The method of claim 35 further comprising the step of:

reporting a likelihood that a type of impairment corresponding to the ratio analysis is affecting the digitally modulated signal.

38. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for identifying impairment of a digitally modulated signal received by the machine, the method steps comprising:

deriving soft decision data from the digitally modulated signal; and

performing ratio analysis on the soft decision data derived from the digitally modulated signal.

39. The program storage device of claim 38 wherein the method steps further comprise:

providing a three-dimensional presentation of a distribution of the soft decision data over time.

40. The program storage device of claim 38 wherein the method steps further comprise:

reporting a likelihood that a type of impairment corresponding to the ratio analysis is affecting the digitally modulated signal.

41. A method for assessing a quality of a digitally modulated signal comprising the steps of:

obtaining soft decision data derived from the digitally modulated signal;

applying an error vector magnitude mask to the soft decision data;

determining a subset of the soft decision data that occur within the error vector magnitude mask; and

calculating a signal-to-noise ratio based on the subset.

42. The method of claim 41 further comprising the step of:

normalizing the soft decision data.

43. A digital receiving apparatus comprising:

a receiver responsive to a digitally modulated signal to perform conversion of digitally modulated signal to soft decision data; and

an error vector magnitude mask subsystem operatively coupled to the receiver and responsive to the soft decision data to assess a quality of the soft decision data.

44. The digital receiving apparatus of claim 43 wherein the error vector magnitude mask subsystem further comprises:

a SNR analyzer operatively coupled to the receiver and responsive to the soft decision data; and

an error vector magnitude mask memory device operatively coupled to the SNR analyzer to provide an error vector magnitude mask to the SNR analyzer.

45. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for identifying impairment of a digitally modulated signal received by the machine, the method steps comprising:

obtaining soft decision data derived from the digitally modulated signal;

applying an error vector magnitude mask to the soft decision data;

determining a subset of the soft decision data that occur within the error vector magnitude mask; and

calculating a signal-to-noise ratio based on the subset.

46. The program storage device of claim 45 wherein the method steps further comprise:

normalizing the soft decision data.